



2019 Results of OPG's Pickering and Darlington Environmental Monitoring Programs

September 18, 2019

ONTARIO **POWER**
GENERATION

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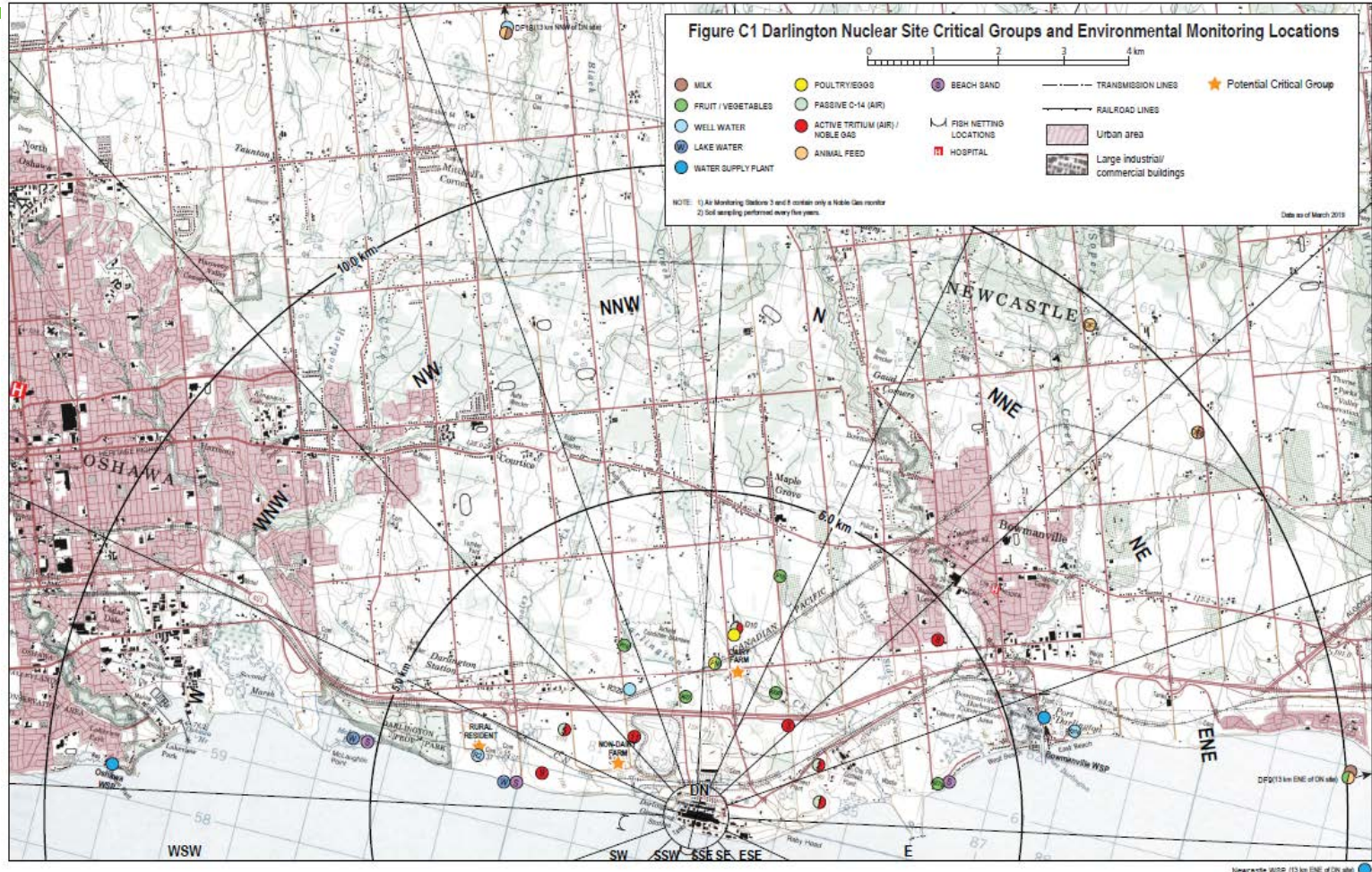
Environmental Monitoring Programs

Key Objectives

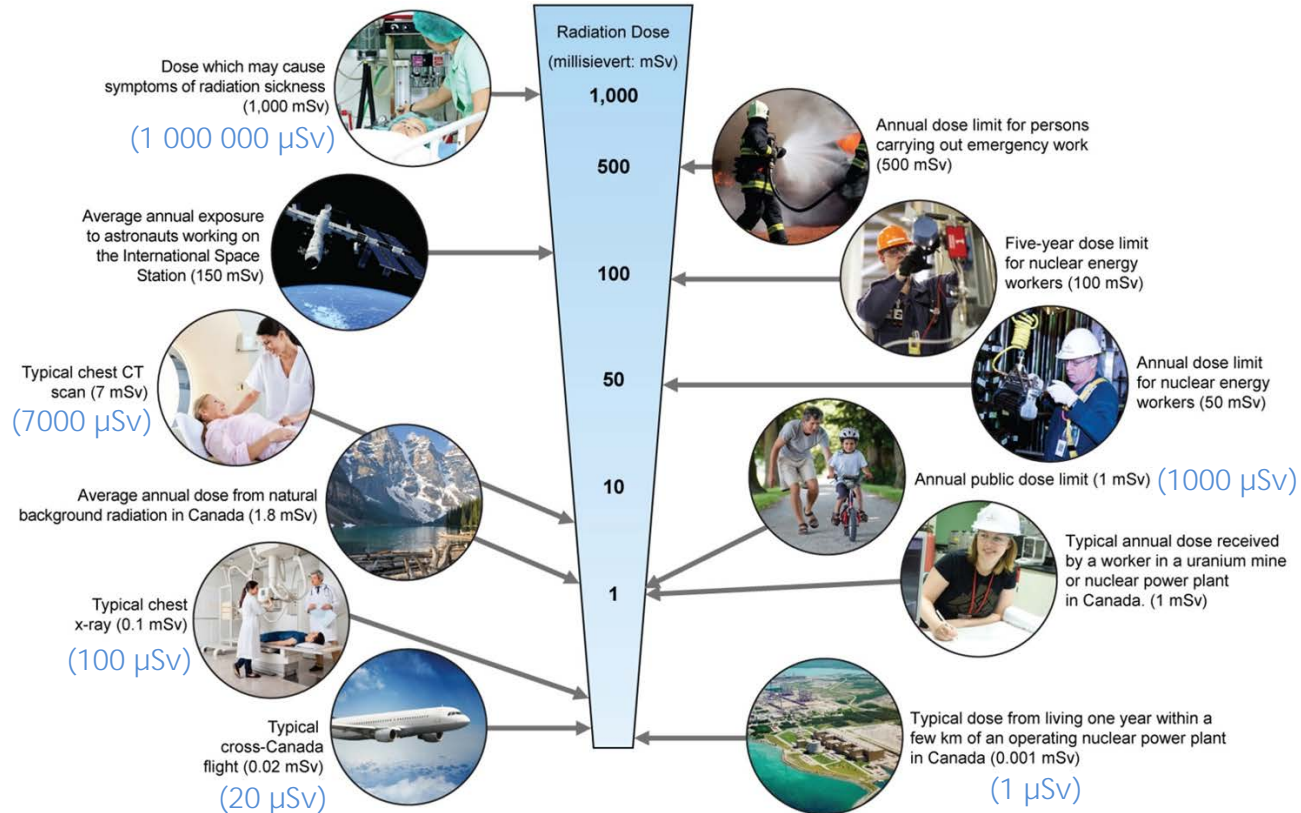
- Demonstrate, independent of effluent monitoring, the effectiveness of containment and effluent control
- Demonstrate compliance with limits on the concentration/intensity of contaminants/physical stressors in the environment
- Provide data to assess the level of risk on human health and the environment and/or to confirm predictions made by environmental risk assessments



DN Critical Groups and Sampling Locations



Radiation Dose Examples

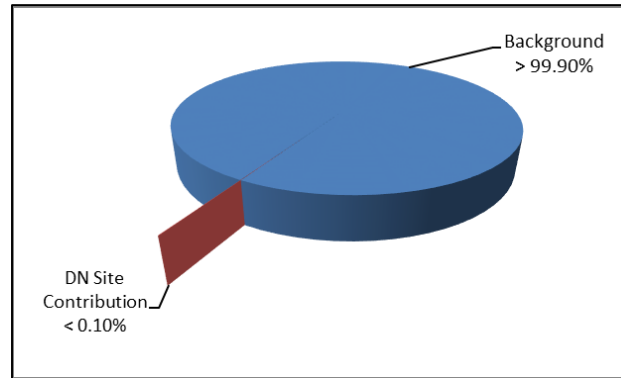
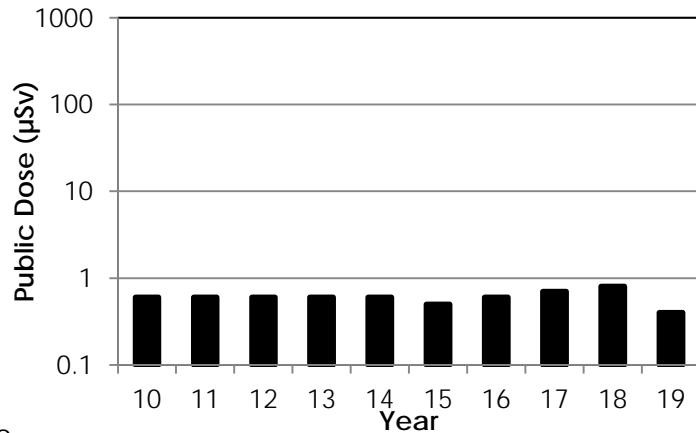


2019 EMP Summary

- Annual public doses resulting from PN and DN operations were 1.7 μSv and 0.4 μSv respectively; 0.2% and < 0.1% of the annual regulatory limit
- Station radiological emissions remained at very small fractions of their respective Derived Release Limits (DRLs)
- Dose calculations and annual report were reviewed and verified by an independent third party
- 2019 EMP report was submitted to CNSC on April 27, 2020 and is available on www.opg.com since June 18, 2020

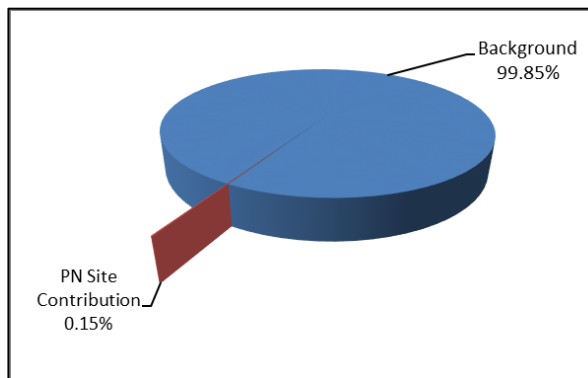
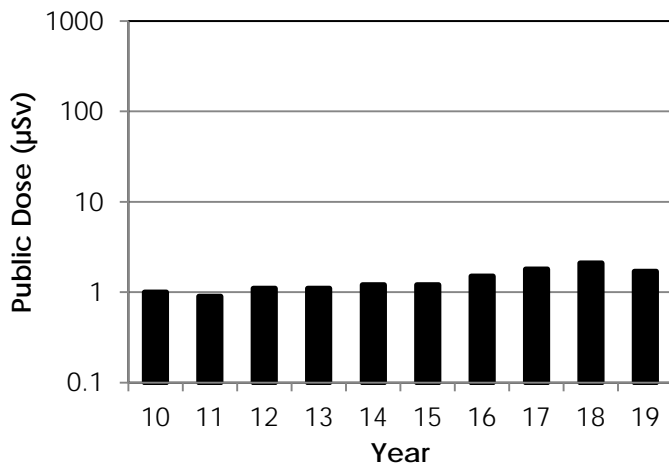
Darlington Station 2019 Public Dose

- 2019 public dose was 0.4 μSv , represented by the Farm adult
- Darlington public dose continues to be very low and is consistent with the 2018 dose
- HTO, C-14, and noble gases are the main dose contributors
- < 0.1% of annual regulatory limit of 1000 μSv and <0.1% of annual natural background radiation of 1,400 μSv



Pickering Station 2019 Public Dose

- 2019 public dose was 1.7 μSv , represented by the Urban Resident adult
- Pickering public dose continues to be very low and is consistent with the 2018 dose
- HTO and noble gases are the main dose contributors
- 0.2% of annual regulatory limit of 1000 μSv and 0.12% of annual natural background radiation of 1,400 μSv



2019 Results of Radioactive Emissions Monitoring

Site Emissions ^(d)	DN		PNA & PNB (Units 1-8) ^(e)	
	Bq	% DRL	Bq	% DRL
AIR				
Tritium Oxide	2.0E+14	0.34	5.6E+14	0.47
Elemental Tritium ^(a)	2.5E+13	<0.01	NA	NA
Noble Gas ^(b)	5.0E+13	0.11	1.3E+14	0.40
I-131 ^(c)	1.4E+08	0.0	1.4E+07	<0.01
Particulate	2.6E+07	<0.01	5.7E+06	<0.01
C-14	9.7E+11	0.28	2.6E+12	0.12
WATER				
Tritium Oxide	1.0E+14	<0.01	4.3E+14	0.12
Gross Beta/Gamma	2.3E+10	3.2E-02	7.8E+10	4.60
C-14	3.8E+08	<0.01	3.5E+09	0.01

NOTES: NA = Not Applicable, Bq = Bequerels

(a) Emissions from Darlington Tritium Removal Facility

(b) Units for noble gas emissions are Bq-MeV

(c) Weekly samples are usually < Method Detection Limit (MDL)

(d) Annual air emissions are the sum of continuous samples analysed weekly.

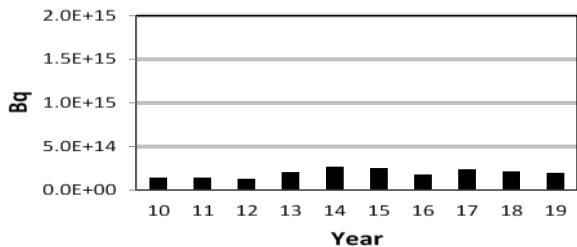
Note that if interim Noble Gas sampling is in place, samples may not be continuous.

Annual water emissions are the sum of monthly composite samples for C-14, and weekly composite samples for tritium oxide and gross beta/gamma.

(e) As of 2019 PN DRLs and emissions are for PNA and PNB combined rather than separate as in the past.

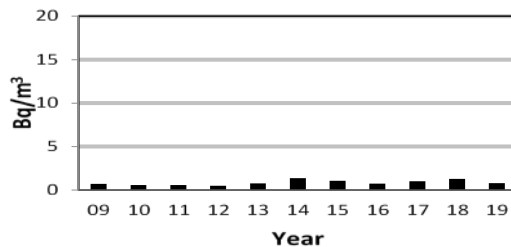
Emissions and EMP Data

DN HTO to Air Emissions



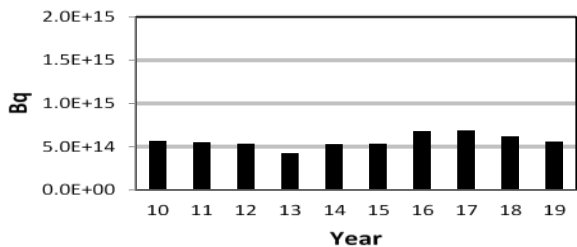
2019 = 2.0×10^{14} Bq

DN HTO to Air at Site Boundary



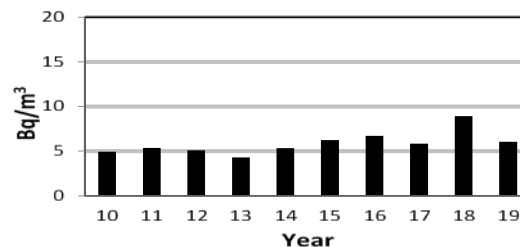
2019 = 0.6 Bq/m³

PN HTO to Air Emissions



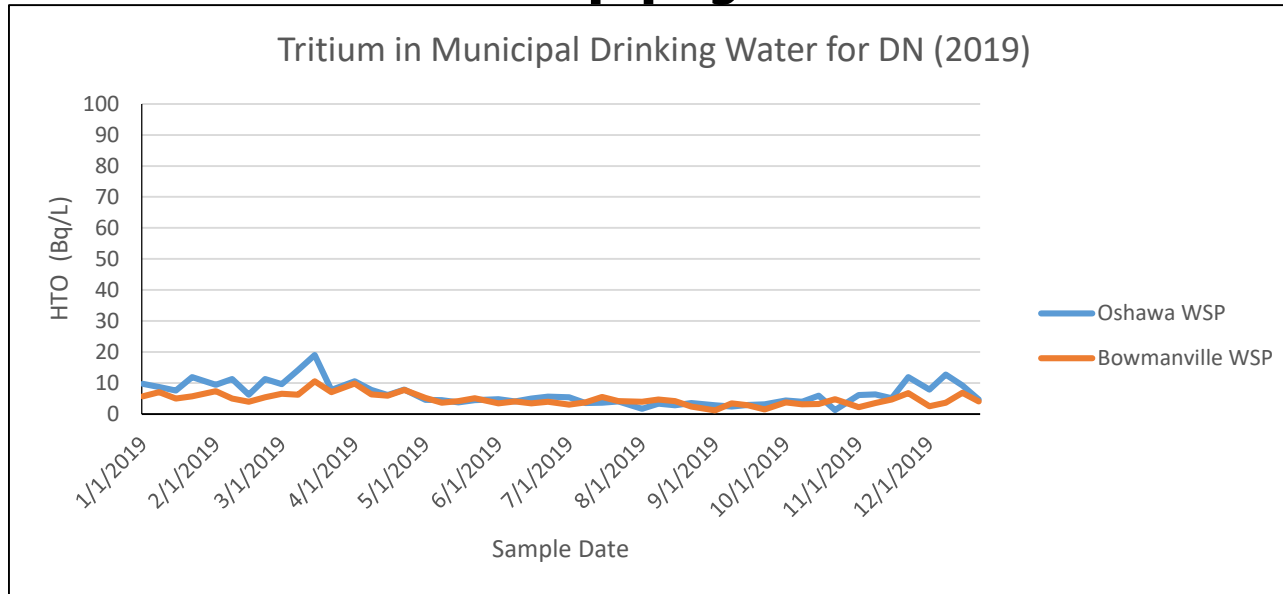
2019 = 5.6×10^{14} Bq

PN HTO to Air at Site Boundary



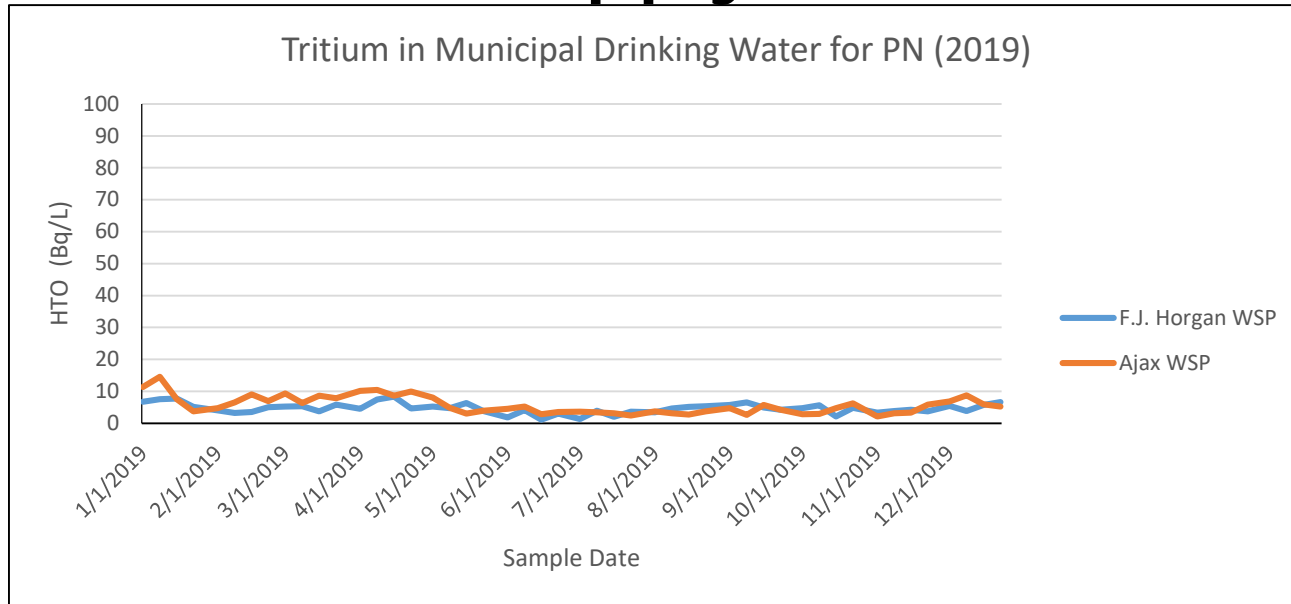
2019 = 6.0 Bq/m³

Tritium at Water Supply Plants near DN



- Average HTO Concentrations: Oshawa = 6.57 Bq/L , Bowmanville = 4.78 Bq/L
- Ontario Drinking Water Quality Standard is 7000 Bq/L
- Water Supply Plant annual average concentrations far below OPG's commitment of < 100 Bq/L

Tritium at Water Supply Plants Near PN



- Average HTO Concentrations: F.J. Horgan = 4.65 Bq/L, Ajax = 5.68 Bq/L
- Ontario Drinking Water Quality Standard is 7000 Bq/L
- Water Supply Plant annual average concentrations far below OPG's commitment of < 100 Bq/L

Results of Non-Radiological Emissions Monitoring

Hazardous Material ^(a)	DN	PN
	Mg	Mg
AIR		
SO ₂ to Air ^{(b)(c)}	1.7E+00	1.3E+00
NO ₂ to Air ^(c)	3.6E+01	2.8E+01
CO ₂ to Air ^{(b)(c)}	1.3E-01	1.0E-01
Ammonia to Air	1.2E+01	6.6E+00
Hydrazine to Air ^(d)	2.0E-02	5.2E-03
Ozone Depleting Substances (ODS) Releases ^(e)	5.2E-02	7.0E-02
WATER		
Ammonia to Water	1.6E+00	5.8E-01
Hydrazine to Water ^(d)	2.3E-01	2.3E-01

- 2019 emissions continue to be reported through 2020, therefore the 2019 EMP Report summarized the complete set of emissions for 2018
- No regulatory non-compliances for 2018 and met all ECA limits

NOTES:

Mg = Megagrams

(a) Hazardous Materials as calculated for NPRI reporting requirements

(b) Reported in OPG Sustainable Development Report as an OPGN aggregate value.

(c) Based on annual fuel consumption.

(d) Based on annual consumption.

(e) Based on estimated quantity when a release occurs.

2019 Environmental Monitoring Program Results

- Site emissions remained at a very small fraction of their respective DRLs.
- 1015 laboratory analyses performed for the 2019 dose calculation.
- The 2019 site public doses remains a small fraction of both the annual legal dose limit and the annual natural background radiation in the area.
- Tritium in drinking water measured at local water supply plants remained at a small fraction of the Ontario Drinking Water Quality Standard of 7000 Bq/L and OPG's voluntary commitment of 100 Bq/L.
- The overall EMPs encompass other programs that are reported separately.



Other Monitoring Programs

Thermal Monitoring

- Discharge of warm water through condenser cooling water system has potential to impact spawning success and larvae development of fish species.
- OPG is performing Thermal and Ambient Lake Water Temperature Monitoring to understand potential impacts from the Pickering and Darlington Stations.
- The average lake temperature at the Darlington Lake Current Monitor December 1st 2018 and March 31st 2019 was 2.0°C, compared to a threshold of 6.0° C.
- There is no indication of a warming trend which would approach the threshold in the near term.



Other Monitoring Programs

Impingement and Entrainment Monitoring Program

- In January 2018 Pickering received an Authorization under Section 35 of the Fisheries Act for the impingement and entrainment of fish resulting from the water taking for the operation of the CANDU reactors. The Authorization requires OPG to offset all fish impacted by the intake of station cooling water.
- The biomass impinged in 2018 was estimated to be 5616 kg, or 1.15 kg/million m³ of station flow.
- Biomass impinged in 2019 will be reported in 2020.



Looking Ahead

- A 2019 supplementary study on hydrazine concentrations in lake water at the outlet of the DN diffuser to analyze the result using a lower detection limit. This study was designed to remove uncertainty surrounding human exposure to hydrazine through drinking water and fish ingestion.
- A 2019 supplementary study on the filtered and unfiltered concentrations of aluminum in the DN CCW to clarify the risk to ecological receptors in Lake Ontario.
- The data from both of the aforementioned studies will be used to inform the next iteration of the DN ERA due for completion in 2021.
- In 2020, no supplementary studies are planned as part of the EMP.
- In 2019 an audit of the EMPs was performed by OPG's Nuclear Oversight department. This assessment was conducted at PN, DN, HPL and OPG Nuclear head office. Overall the assessment determined that the EMP is being effectively managed in meeting the requirements of CSA N288.4-10.

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